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<b>(21) Internationales Aktenzeichen:</b> PCT/EP95/04792 <b>(22) Internationales Anmeldedatum:</b> 6. December 1995 (06.12.95)  <b>(30) Prioritätsdaten:</b> 195 19 399.7      26. Mai 1995 (26.05.95)      DE  <b>(71) Anmelder (für alle Bestimmungsstaaten ausser US):</b> INA WÄZLAGER SCHAEFFLER KG [DE/DE]; D-91072 Herzogenaurach (DE).  <b>(72) Erfinder; und</b> <b>(75) Erfinder/Anmelder (nur für US):</b> SPEIL, Walter [DE/DE]; Friedrich-Ebert-Strasse 60b, D-85055 Ingolstadt (DE). HAAS, Michael [DE/DE]; Karlsbader Strasse 2, D-91085 Weisendorf (DE).  <b>(74) Gemeinsamer Vertreter:</b> INA WÄZLAGER SCHAEFFLER KG; D-91072 Herzogenaurach (DE).		<b>(81) Bestimmungsstaaten:</b> DE, JP, US.  <b>Veröffentlicht</b> <i>Mit internationalem Recherchenbericht.</i>

**(54) Title:** VALVE GEAR FOR AN INTERNAL COMBUSTION ENGINE

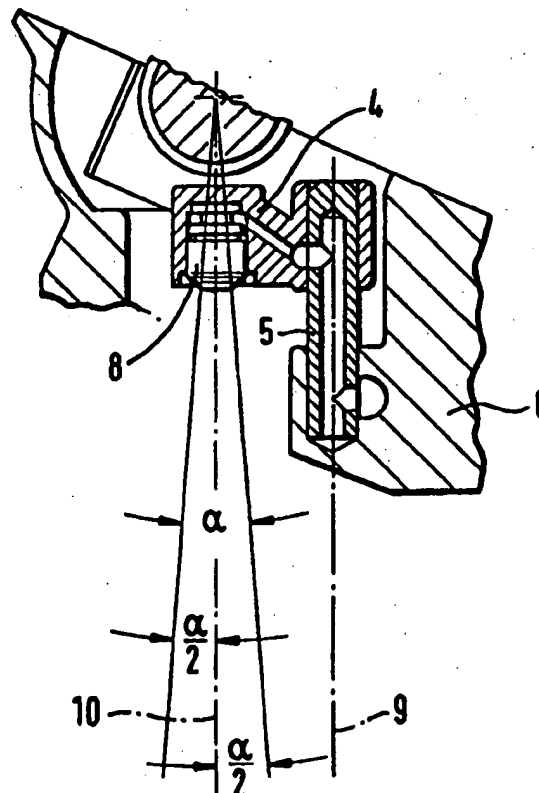
**(54) Bezeichnung:** VENTILTRIEB EINER BRENNKRAFTMASCHINE

**(57) Abstract**

The invention concerns valve gear (1) for simultaneously actuating, for example, three equally acting gas-exchange valves (2), longitudinal axes of the gas-exchange valves (2) being disposed such that they form an angle relative to one another. According to the invention, a bridge (4) is disposed between cams on a camshaft (3) and the gas-exchange valves (2), the guide means (5) of the bridge (4) extending with its longitudinal axis (9) parallel to a median line (10) between the longitudinal axes of the gas-exchange valves (2a, 2b).

**(57) Zusammenfassung**

Bei einem Ventiltrieb (1) zur gleichzeitigen Betätigung von beispielsweise drei gleichwirkenden Gaswechselventilen (2), sind Längsachsen der Gaswechselventile (2) einen Winkel zueinander einschließend angeordnet. Zwischen Nocken einer Nockenwelle (3) und den Gaswechselventilen (2) ist erfindungsgemäß eine Brücke (4) angeordnet, deren Führungsmittel (5) mit ihrer Längsachse (9) parallel zu einer Winkelhalbierenden (10) zwischen den Längsachsen der Gaswechselventile (2a, 2b) verläuft.



## Bezeichnung der Erfindung

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Ventiltrieb einer Brennkraftmaschine

## Beschreibung

10

### Gebiet der Erfindung

Die Erfindung betrifft einen Ventiltrieb einer Brennkraftmaschine mit zumindest zwei von wenigstens einem Nocken einer Nockenwelle im Hubsinn beaufschlagten gleichwirkenden Gaswechselventilen, welche Gaswechselventile unter  
15 einem kleinen definierten Winkel zueinander verlaufen.

### Hintergrund der Erfindung

- 20 Derartige Mehrventiltriebe werden in zunehmendem Maße im Motorenbau eingesetzt. Beispielsweise ist aus der Fachzeitschrift MTZ - Motortechnische Zeitschrift H. 2 (1995) ein Vierzylindermotor mit Fünfventiltechnik bekannt, bei dem je Zylinder drei Einlaß- und zwei Auslaßventile appliziert sind. Pro Zylinder werden demnach fünf tassenförmige Stößel als Übertragungsmittel benötigt.
- 25 Zugleich sind die Einlaßventile auf zwei unterschiedlichen Ebenen zueinander angeordnet (zwei Ventile auf einer Ebene), hervorgerufen durch eine ballige Ausbildung der Brennraumoberfläche und begrenzt zur Verfügung stehenden freigebbaren Gaswechselquerschnitt. Die Beaufschlagung der windschief zueinander angeordneten Einlaßventile erfordert je Einlaßventil einen aufwendig zu
- 30 schleifenden Nocken.

Ein wesentlicher Grundgedanke der Erfindung ist es, die Brücke so anzuordnen, daß die Gaswechselventile mit ihren Schaftenden nur eine geringe Auswanderungsbewegung auf einer Unterseite der Brücke an den Übertragungsmitteln dieser ausführen. Dies wird durch die eben beschriebene Anordnung des

5 Führungsmittels der Brücke parallel zu einer Winkelhalbierenden zwischen den Ebenen der Gaswechselventile hergestellt. Da jedoch, wie beispielsweise bei der im nachfolgenden Anspruch beschriebenen Ventilausbildung zwei gleichwirkende Gaswechselventile auf einer Ebene liegen, wird durch diese zwei gleichwirkenden Gaswechselventile gegenüber dem dritten Gaswechselventil

10 eine weitaus größere Reaktionskraft in das Führungsmittel geleitet. Somit wird gemäß der Erfindung vorgeschlagen, die Führungsmittel der Brücke nicht unbedingt parallel zu der Winkelhalbierenden sondern parallel zu einer Längsachse anzuordnen, auf welcher die Summe der von der Brücke auf die Führungsmittel einwirkenden Reaktionskräfte minimal ist.

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Eine Ausbildung und Anordnung der erfindungsgemäß hier dargelegten Brücke bezieht sich jedoch nicht nur auf die näher beschriebene Zwei- bzw. Dreiventiltechnik (für gleichwirkende Gaswechselventile je Zylinder). Betrachtet man beispielsweise einen Ventiltrieb mit einer beliebigen Zahl von gleichwirkenden

20 Gaswechselventilen je Zylinder, welche Gaswechselventile beispielsweise windschief zueinander oder aber auch windschief zueinander und nur teilweise auf Längsachsen, welche die Nockenwellenachse schneiden, angeordnet sind, so soll immer durch die Anordnung der Führungsmittel für die erfindungsgemäße Brücke gesichert sein, daß wahlweise bei Ventilhub die Gaswechselventile

25 in ihrer Summe eine geringste Auswanderung an den brückenseitigen Übertragungsmitteln vollziehen bzw. daß die erwähnte Summe der Reaktionskräfte minimal ist.

Vorteilhaft ist es, wenn als Übertragungsmittel in der Brücke zum Gaswechsel-

30 ventil je Ventil ein hydraulisches Spielausgleichselement appliziert ist. Denkbar ist es jedoch auch, auf an sich bekannte mechanische Einstellvarianten zurückzugreifen bzw. auf eine Kombination der letztgenannten.

### Kurze Beschreibung der Zeichnungen

Zweckmäßigerweise ist die Erfindung in der Zeichnung dargestellt. Es zeigen:

- 5       Figur 1     eine schematische Darstellung eines Ventiltriebs, so wie er aus dem Stand der Technik bekannt ist;
- Figur 2     eine Draufsicht auf einen erfindungsgemäßen Nockenfolger und
- 10       Figur 3     in einer Teilansicht einen Querschnitt durch den erfindungsgemäßen Nockenfolger im Bereich seiner Führungsmittel.

### Ausführliche Beschreibung der Zeichnungen

- 15       Figur 1 zeigt einen gattungsgemäßen Ventiltrieb 1. Dieser besteht aus drei gleichwirkenden Gaswechselventilen 2 (Einlaßventile). Zwei äußere Gaswechselventile 2a weisen nach dieser einen hier beschriebenen beispielhaften Ausführungsform Längsachsen auf, die zumindest annähernd auf einer Ebene liegen.
- 20   In Längsrichtung einer Nockenwelle 3, deren Nocken die Gaswechselventile 2 im Hubsinne beaufschlagen, liegt zwischen den Gaswechselventilen 2a ein weiteres Gaswechselventil 2b, mit einem Winkel zu der Ebene der Gaswechselventile 2a. Die Längsachsen der Gaswechselventile 2 schneiden hier in etwa die Längsachse der Nockenwelle 3.

- 25       Wie die nachfolgenden Figuren 2 und 3 zeigen, ist zwischen den Nocken der Nockenwelle 3 und den Gaswechselventilen 2 eine Brücke 4 angeordnet. Diese Brücke 4 ist über nicht näher zu beschreibende Führungsmittel 5 gegenüber einem Zylinderkopf 6 der Brennkraftmaschine längsbeweglich geführt. Zugleich
- 30   weist die Brücke 4 nockenseitig zwei Rollen 7 als unmittelbare Anlaufmittel für die Nocken der Nockenwelle 3 auf. Durch diese Rollen 7 ist ein besonders reibungsarmer Abgriff des Nockenhubes an der Brücke 4 geschaffen. Ventilseitig

### Liste der Bezugsszahlen

- 5 1 Ventiltrieb
- 2 Gaswechselventil
- 3 Nockenwelle
- 4 Brücke
- 5 Führungsmittel
- 10 6 Zylinderkopf
- 7 Rolle
- 8 Spielausgleichselement
- 9 Längsachse
- 10 Winkelhalbierende

4. Ventiltrieb nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß als ventilseitiges Übertragungsmittel in der Brücke (4) zu den Gaswechselventilen (2) zumindest ein hydraulisches Spielausgleichselement (8) appliziert ist.
- 5 5. Ventiltrieb nach Anspruch 1 oder 2, dadurch gekennzeichnet, daßnocken-  
seitige Anlaufmittel in der Brücke (4) als drehbare(r) Rolle/Bolzen (7) ausgebildet  
sind.
6. Ventiltrieb nach Anspruch 5, dadurch gekennzeichnet, daß der Nockenfolger  
10 (Brücke (4)) von zwei gleichwirkenden Nocken beaufschlagt ist, denen je ein  
Anlaufmittel (Rolle (7)) in der Brücke (4) zugewandt ist.
7. Ventiltrieb nach Anspruch 2 und 6, dadurch gekennzeichnet, daß die Anlauf-  
mittel (Rollen (7)) in der Brücke (4), in Draufsicht auf diese gesehen, beidseitig  
15 des weiteren (mittigen) Gaswechselventils (2b) angeordnet sind.

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Fig. 2

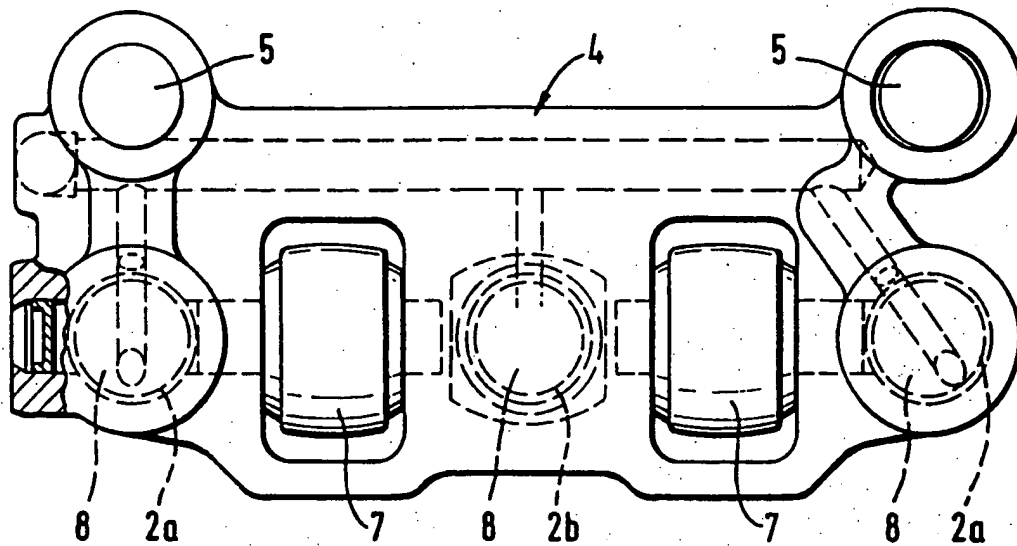
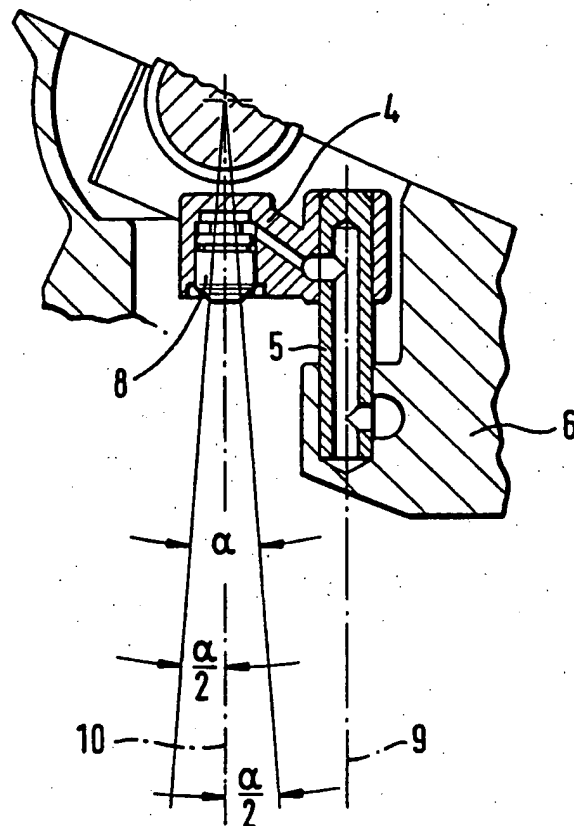


Fig. 3



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 95/04792

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-4338845	24-05-95	NONE	
FR-A-2662743	06-12-91	NONE	
US-A-4809663	07-03-89	NONE	
US-A-4660529	28-04-87	JP-C- 1582480	11-10-90
		JP-B- 2004765	30-01-90
		JP-A- 57176311	29-10-82
		JP-C- 1865395	26-08-94
		JP-B- 2014961	10-04-90
		JP-A- 58113512	06-07-83
		EP-A,B 0063385	27-10-82
		US-E- RE33787	07-01-92



# INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen

PCT/EP 95/04792

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
DE-A-4338845	24-05-95	KEINE	
FR-A-2662743	06-12-91	KEINE	
US-A-4809663	07-03-89	KEINE	
US-A-4660529	28-04-87	JP-C- 1582480	11-10-90
		JP-B- 2004765	30-01-90
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		JP-B- 2014961	10-04-90
		JP-A- 58113512	06-07-83
		EP-A,B 0063385	27-10-82
		US-E- RE33787	07-01-92

## Valve gear for an internal combustion engine

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 Inventor(s): HAAS MICHAEL (DE); SPEIL WALTER (DE)  
 Applicant(s): INA WALZLAGER KG (DE)  
 Requested Patent: WO9637687  
 Application Number: US19970952828 19971125  
 Priority Number(s): DE19951019399 19950526; WO1995EP04792 19951206  
 IPC Classification: F01L1/26  
 EC Classification: F01L1/14B; F01L1/26B  
 Equivalents: DE19519399

### Abstract

PCT No. PCT/EP95/04792 Sec. 371 Date Nov. 25, 1997 Sec. 102(e) Date Nov. 25, 1997 PCT Filed Dec. 6, 1995 PCT Pub. No. WO96/37687 PCT Pub. Date Nov. 28, 1996 In a valve drive (1) for the simultaneous actuation of, for instance, three equally acting gas exchange valves (2), longitudinal axes of the gas exchange valves (2) are arranged so as to include an angle therebetween wherein a bridge (4) is arranged between the cams of a camshaft (3) and the gas exchange valves (2), and the longitudinal axis (9) of the guide means (5) of the bridge (4) extends parallel to a bisectrix (10) between the longitudinal axes of the gas exchange valves (2a, 2b).

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## Description

### FIELD OF THE INVENTION

The invention concerns a valve drive of an internal combustion engine comprising at least two equally acting gas exchange valves loaded in lifting direction by at least one cam of a camshaft, said gas exchange valves extending at a small, defined angle to each other.

### BACKGROUND OF THE INVENTION

Multi-valve drives of the aforesaid type are being increasingly used in engine construction. The technical journal MTZ—Motortechnische Zeitschrift—No. 2, 1995, for instance, describes a four-cylinder engine with a five-valve technique i.e., with three intake and two exhaust valves per cylinder. Therefore, five cup-shaped tappets are required for each cylinder as transmitting elements. The intake valves are arranged on two different planes (two valves being arranged on a common plane), because the outer surface of the combustion chamber is domed and the available valve cross-section is limited. The loading of the intake valves disposed at a slant to one another necessitates a cam produced by complicated grinding for each intake valve.

### OBJECT OF THE INVENTION

It is therefore an object of the invention to create a valve drive of the pre-cited type in which the aforesaid drawbacks are substantially eliminated and particularly to provide a simultaneous loading of at least two equally acting gas exchange valves using fewer parts and less complicated manufacturing procedures.

### SUMMARY OF THE INVENTION

The valve drive (1) of the invention of an internal combustion engine comprising at least two equally acting gas exchange valves (2) loaded in lifting direction by at least one cam of a camshaft (3), said gas exchange valves (2) extending at a small, defined angle to each other, is in that a cam follower is arranged in driving relationship between the cam(s) and the gas exchange valves, the cam follower comprising a bridge which is guided for linear displacement relative to a cylinder head of the external combustion engine by guide means, and a longitudinal axis extending through the guide means of the bridge is at least approximately parallel to a bisector of the angle, or the longitudinal axis extending through the guide means is approximately parallel to a longitudinal axis situated between the

longitudinal axes of the gas exchange valves, along which longitudinal axis, a sum of the reaction forces acting from the bridge on the guide means is zero or minimal.

The bridge described herein which, for example, can have a girder-like configuration, enables an equally acting loading of at least two gas exchange valves. Longitudinal axes of the gas exchange valves can extend, for example, so that their point of intersection is situated on the side of camshaft-proximate ends of the gas exchange valves (see description of figures). Thus only at least one cam is required for each cylinder and number of equally acting valves. Another minimal requirement consists in that only one transmitting element is required in the bridge for transmission to the gas exchange valve. At the same time, the otherwise complicated manufacturing of cams for each gas exchange valve is simplified.

An essential basic idea of the invention is to arrange the bridge so that the ends of the valve stems can only migrate to a small extent on the transmitting elements on the under surface of the bridge. This is achieved by the previously described arrangement of the guide means of the bridge parallel to a bisector between the planes of the gas exchange valves. Since, however, as is the case in the example of valve configuration, two same function gas exchange valves are situated on one common plane, a much larger reaction force is transmitted to the guide means by these two same function gas exchange valves than by the third gas exchange valve. According to the invention therefore, the guide means of the bridge is not necessarily arranged parallel to the bisector but parallel to a longitudinal axis along which the sum of the reaction forces acting from the bridge on the guide means is minimal.

However, the configuration and arrangement of the bridge of the invention does not apply only to the two and three valve technique (for same function gas exchange valves per cylinder) specifically described herein. If one considers, for instance, a valve drive with any desired number of same function gas exchange valves per cylinder, and these gas exchange valves are arranged, for example, at a slant to one another, or at a slant to one another and only partly along longitudinal axes which intersect the axis of the camshaft, the arrangement of the guide means of the bridge of the invention must be such that it assured either that the total migration of the gas exchange valves during valve lift on the transmitting elements provided in the bridge is as small as possible, or that the sum of the aforesaid reaction forces mentioned above is minimal.

Advantageously, one hydraulic clearance compensation element per valve is arranged as transmitting means in the bridge for transmission to the gas exchange valve. It is also conceivable, however, to use known mechanical adjusting devices or their combinations.

A particularly favorable embodiment of contacting elements for the cams in the bridge from the tribological point of view likewise forms a subject matter of the invention. Such contacting elements are configured in the form of rotating rollers or pins.

According to a further proposition of the invention, when the bridge is used for three equally acting gas exchange valves, the bridge is loaded by two equally acting cams each of which cooperates with one contacting means in the bridge.

Further, the counter surface of the transmitting element can be made slightly spherical or cylindrical so as to provide a sufficiently large contact surface for the gas exchange valve during its migration relative to the transmitting element during cam lift. It is equally conceivable to provide the transmitting element (clearance compensation element) with pivoting slide shoes known, per se, from the prior art.

It is advantageous for the oscillating masses in the valve drive, to make the bridge of the invention by a lightweight technique or of a light material such as aluminium. A construction out of a plastic is likewise suitable. However, it is also possible to make the bridge by a conventional method out of steel. Further, the configuration of the guide means for the bridge is not limited to the example of embodiment represented in the attached drawings. It is conceivable to use any guide means known from the state of the art.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a prior art valve drive,

FIG. 2 shows a top view of a cam follower of the invention, and

FIG. 3 is a partial cross-sectional view of the cam follower of the invention in the region of its guide means.

#### DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a valve drive 1 of a generic type. This valve drive comprises three equally acting gas exchange valves 2 (intake valves). In this particular embodiment described here by way of example, two outer gas exchange valves 2a have longitudinal axes situated at least approximately on one common plane. In the longitudinal direction of a camshaft 3 whose cams load the gas exchange valves 2 in lifting direction, there is arranged between the gas exchange valves 2a, a further gas exchange valve 2b extending at an angle to the plane of the gas exchange valves 2a. The longitudinal

axes of the gas exchange valves 2 roughly intersect the longitudinal axis of the camshaft 3.

As can be seen from FIGS. 2 and 3, a bridge 4 is arranged between the cams of the camshaft 3 and the gas exchange valves 2. This bridge 4 is guided for linear displacement relative to a cylinder head 6 of an internal combustion engine by guide means 5 needing no further description here. On its side facing the cams, the bridge 4 comprises two rollers 7 serving as direct contacting elements for the cams of the camshaft 3. These rollers 7 permit a particularly low-friction transmission of the cam lift to the bridge 4. On its side facing the valves, the bridge 4 comprises transmitting elements in the form of one hydraulic clearance compensation element 8 for each gas exchange valve 2.

As can be seen from FIG. 3, a longitudinal axis 9 of the guide means 5 is arranged parallel to a bisector 10 between the plane extending through the longitudinal axes of the equally acting gas exchange valves 2a and the longitudinal axis of the gas exchange valve 2b. To form a sufficiently large contact surface for the end of the respective valve stem on the counter surface of the clearance compensation element 8, this counter surface (not shown) can be given a spherical or cylindrical shape. It is also conceivable, however, to have the axis of symmetry of each transmitting element extend approximately or exactly along the longitudinal axis of the respective gas exchange valve.

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## Claims

We claim:

1. A valve drive (1) of an internal combustion engine comprising at least two gas exchange valves (2) of the same function loaded in a lifting direction by at least one cam of a camshaft (3), said gas exchange valves (2) extending at a small, defined angle to each other, characterized in that a cam follower is arranged in driving relationship between the at least one cam and the gas exchange valves, the cam follower comprising a bridge (4) which is guided for linear displacement relative to a cylinder head (6) of the internal combustion engine by guide means (5), and a longitudinal axis (9) extending through the guide means (5) of the bridge (4) is substantially parallel to a bisector (10) of the angle, or the longitudinal axis extending through the guide means (5) is substantially parallel to a longitudinal axis situated between the longitudinal axes of the gas exchange valves (2) wherein a sum of the reaction forces acting from the bridge (4) on the guide means (5) is substantially zero.
2. A valve drive of claim 1 comprising three of the gas exchange valves (2) of the same function of which two first gas exchange valves (2a) have longitudinal axes situated approximately on one common plane, there being arranged in a longitudinal direction of the camshaft between said two first gas exchange valves (2a), a further gas exchange valve (2b) which extends at an angle to said common plane, wherein the longitudinal axis (9) of the guide means (5) of the bridge (4) extends approximately parallel to a plane which is situated between the common plane of the first gas exchange valves (2a) and a bisector between the common plane of the first gas exchange valves (2a) and the longitudinal axis of the further gas exchange valve (2b).
3. A valve drive of claim 1 wherein the longitudinal axis of at least one of the gas exchange valves (2) intersects the longitudinal axis of the camshaft.
4. A valve drive of claim 1 wherein at least one hydraulic clearance compensation element (8) is arranged in the bridge (4) to face the gas exchange valves (2) and act as a transmitting element to the gas exchange valves (2).
5. A valve drive of claim 1 wherein cam contacting elements in the bridge (4) are configured as rotating rollers or pins (7).
6. A valve drive of claim 5 wherein, the bridge (4) is loaded by two equally acting cams each of which is situated opposite one roller (7) arranged in the bridge (4).
7. A valve drive of claim 2 wherein, seen in a top view of the bridge (4), the further gas exchange valve (2b) is located between the two cam contacting elements.
8. A valve drive of claim 2 wherein the longitudinal axis of at least one of the gas exchange valve (2) intersects the longitudinal axis of the camshaft.
9. A valve drive of claim 2 wherein at least one hydraulic clearance compensation element (8) is arranged in the bridge (4) to face the gas exchange valves (2) and act as a transmitting element to the gas exchange valves (2).
10. A valve drive of claim 2 wherein cam contacting elements in the bridge (4) are configured as rotating rollers or pins (7).
11. A valve drive of claim 6 wherein, seen in a top view of the bridge (4), the further gas exchange valve (2b) is located between the two cam contacting elements.

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